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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Patent of:

HAMPDEN-SMITH et al.

Patent No. 7,022,261 B2

Issued: April 4, 2006

Confirmation No.: 4301

Atty. File No.: 41890-01672

For: "SULFUR-CONTAINING PHOSPHOR  
POWDERS, METHODS FOR  
MAKING PHOSPHOR POWDERS  
AND DEVICES INCORPORATING  
SAME"

REQUEST FOR CERTIFICATE OF  
CORRECTION OF PATENT UNDER 37  
C.F.R. SECTIONS 1.322(a) AND 1.323

<p>CERTIFICATE OF MAILING</p> <p>I HEREBY CERTIFY THAT THIS CORRESPONDENCE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE AS FIRST CLASS MAIL IN AN ENVELOPE ADDRESSED TO COMMISSIONER FOR PATENTS, P.O. BOX 1450, ALEXANDRIA, VA 22313-1450 ON _____</p> <p>BY: <u>Valerie Bey</u> MARSH FISCHMANN &amp; BREYFOGLE LLP</p>
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Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

04/19/2006 CNEBA1 00000040 7022261  
01 FC:1811 100.00 GP

Certificate

APR 20 2006

of Correction

Dear Sir or Madam:

This is a request for a Certificate of Correction for PTO mistake under 37 C.F.R. 1.322(a). The errors in the patent are obvious typographical errors or omissions and the correct wording can be found in either the original specification at Page 37, lines 4 and 14, Page 85, line 22, Page 87, line 20, and Page 88, line 4 or the Response to Office Action dated January 7, 2005, at Page 7, line 20. Attached is form PTO 1050 in duplicate along with copies of documentation that unequivocally supports patentee's assertion(s).


This is also a request in relation to the above-identified U.S. Patent for issuance of a Certificate of Correction for Applicant's mistake. The errors in the patent are obvious typographical errors. Attached in duplicate is form PTO 1050 and a check in the amount of \$100.00 to cover the

APR 21 2006

fee set forth in 37 C.F.R. Section 1.20(a). Please credit any over-payment or debit any underpayment to Deposit Account No. 50-1419.

Respectfully submitted,

MARSH FISCHMANN & BREYFOGLE LLP

By: 

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APR 21 2006

UNITED STATES PATENT AND TRADEMARK OFFICE

**CERTIFICATE OF CORRECTION**

PATENT NO. : 7,022,261 B2

DATED : April 4, 2006

INVENTOR(S): HAMPDEN-SMITH et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 20

Line 44, delete "□m" and insert therefor --μm--;

Line 59, delete "preferabley" and insert therefor --preferably--.

Column 35

Line 62, delete "acivator" and insert therefor --activator--.

Column 47

Line 25, delete "elecroluminescent" and insert therefor --electroluminescent--.

Column 48

Line 28, delete "elecroluminescent" and insert therefor --electroluminescent--;

Line 42, delete "Preferabley" and insert therefor --Preferably--.

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preferably to remove droplets of a size larger than about 8  $\mu\text{m}$  in size and most preferably to remove droplets larger than about 5  $\mu\text{m}$  in size. The droplet classification size in the droplet classifier is preferably smaller than about 15  $\mu\text{m}$ , more preferably smaller than about 10  $\mu\text{m}$ , even more preferably smaller than about 8  $\mu\text{m}$  and most preferably smaller than about 5  $\mu\text{m}$ .

5 The classification size, also called the classification cut point, is that size at which half of the droplets of that size are removed and half of the droplets of that size are retained. Depending upon the specific application, however, the droplet classification size may be varied, such as by changing the spacing between the impactor plate 302 and the flow control plate 290 or increasing or decreasing aerosol velocity through the jets in the flow control plate 290.

10 Because the aerosol generator 106 of the present invention initially produces a high quality aerosol 108, having a relatively narrow size distribution of droplets, typically less than about 30 weight percent of liquid feed 102 in the aerosol 108 is removed as the drain liquid 284 in the droplet classifier 288, with preferably less than about 25 weight percent being removed, even more preferably less than about 20 weight percent being removed and most

15 preferably less than about 15 weight percent being removed. Minimizing the removal of liquid feed 102 from the aerosol 108 is particularly important for commercial applications to increase the yield of high quality particulate product 116. It should be noted, however, that because of the superior performance of the aerosol generator 106, it is frequently not required to use an impactor or other droplet classifier to obtain a desired absence of oversize droplets

20 to the furnace. This is a major advantage, because the added complexity and liquid losses accompanying use of an impactor may often be avoided with the process of the present invention.

Sometimes it is desirable to use both the aerosol concentrator 236 and the droplet classifier 280 to produce an extremely high quality aerosol stream for introduction into the

An EL display is schematically illustrated in Figs. 56 and 57. The EL display device 1120 includes a phosphor layer 1122 sandwiched between two dielectric insulating layers 1124 and 1126. On the back side of the insulating layers is a backplate 1128 which includes row electrodes 1130. On the front of the device is a glass faceplate 1132 which includes transparent column electrodes 1134, such as electrodes made from transparent indium tin oxide.

While current electroluminescent display configurations utilize a thin film phosphor layer 1122 and do not typically utilize phosphor powders, the use of very small monodispersed phosphor particles according to the present invention is advantageous for use in such devices. For example, small monodispersed particles could be deposited on a glass substrate using a thick film paste and sintered to produce a well connected film and therefore could replace the expensive and material-limited CVD technology currently used to deposit such films. Such a well-connected film could not be formed from large, agglomerated phosphor particles. Similarly, composite phosphor particles are a viable alternative to the relatively expensive multilayer stack currently employed in electroluminescent displays. Thus, a composite phosphor particle comprising the phosphor and a dielectric material could be used.

Particularly preferred phosphors for use in electroluminescent display applications include the metal sulfides such as  $\text{ZnS:Cu}$ ,  $\text{BaS:Ce}$ ,  $\text{CaS:Ce}$ ,  $\text{SrS:RE}$  (RE = rare earth), and  $\text{ZnS:Mn}$ . Further, mixed metal sulfides such as  $\text{Sr}_x\text{Ca}_y\text{Ba}_{1-x-y}\text{S}_N\text{:Ce}$  can be used. Further, the thiogallate phosphors according to the present invention can also have advantages for use in electroluminescent displays.

Another display device for which the phosphors according to the present invention are useful are liquid crystal displays (LCD), and in particular active matrix liquid crystal displays

especially when filtered to generate other colors. Additional colors, higher reliability and higher brightness powders are critical needs for the electroluminescent lamp industry to supply designers with the ability to penetrate new market segments. The phosphor layers should also be thinner and denser, without sacrificing brightness, to minimize water intrusion and eliminate light scattering. Higher brightness electroluminescent lamps require thinner phosphor layers, which requires smaller particle size phosphor powders that cannot be produced by conventional methods. Such thinner layers will also use less phosphor powder. Presently available EL lamps utilize powders having an average size of about  $5\text{ }\mu\text{m}$  or higher. The phosphor powders of the present invention having a small particle size and narrow size distribution, will enable the production of brighter and more reliable EL lamps that have an increased life-expectancy. Further, the phosphor powders of the present invention will enable the production of EL lamps wherein the phosphor layer has a significantly reduced thickness, without sacrificing brightness or other desirable properties. Conventional EL lamps have phosphor layers on the order of  $100\text{ }\mu\text{m}$  thick. The powders of the present invention advantageously enable the production of an EL lamp having a phosphor layer that is not greater than about  $15\text{ }\mu\text{m}$  thick, such as not greater than about  $10\text{ }\mu\text{m}$  thick. The phosphor layer is preferably not thicker than about 3 times the weight average particle size, more preferably not greater than about 2 times the weight average particle size.

As discussed above, preferred electroluminescent sulfur-containing phosphors for use in electroluminescent lamps include  $\text{ZnS:Cu}$  for blue or blue-green and  $\text{ZnS:Mn, Cu}$  for orange. Other materials that are desirable for EL lamp applications include  $\text{BaS:RE, Cu}$  or  $\text{Mn}$ ,  $\text{CaS:RE}$  or  $\text{Mn}$ ,  $\text{SrS:RE}$  or  $\text{Mn}$ , and  $\text{Sr}_x\text{Ca}_y\text{Ba}_{1-x-y}\text{S:RE}$  (where RE is a rare earth element) for other colors.  $\text{CaS:Ga}$  or  $\text{Cu}$  and  $\text{SrS:Ga}$  or  $\text{Cu}$  are also useful. The thiogallate phosphors of the present invention, such as  $\text{SrGa}_2\text{S}_4$  and  $\text{CaGa}_2\text{S}_4$ , can be particularly advantageous for use in

electroluminescent lamps. As is discussed above, many of these phosphors cannot be produced using conventional techniques and therefore have not been utilized in EL lamp applications. When used in an EL lamp, these phosphors should be coated to prevent degradation of the phosphor due to hydrolysis or other adverse reactions. Preferably, such a coating has an average thickness of from about 2 to 50 nanometers.

As stated above, electroluminescent lamps are becoming increasingly important for back lighting alphanumeric displays in small electronic devices such as cellular phones, pagers, personal digital assistants, wrist watches, calculators and the like. They are also useful in applications such as instrument panels, portable advertising displays, safety lighting, emergency lighting for rescue and safety devices, photographic backlighting, membrane switches and other similar applications. One of the problems associated with electroluminescent devices is that they generally require the application of alternating current (AC) voltage to produce light. A significant obstacle to the development of the useful direct current (DC) electroluminescent (DCEL) devices is a need for a phosphor powder that will function adequately under a DC electric field. The phosphor powder for functioning under a DC electric field should meet at least three requirements: 1) the particles should have a small average particle size; 2) the particles should have a uniform size, that is, the particles should have a narrow size distribution with no large particles or agglomerates; and 3) the particles should have good luminescence properties, particularly a high brightness. The phosphor powders of the present invention advantageously meet these requirements. Therefore, the phosphor powders of the present invention will advantageously permit the use of electroluminescent devices without requiring an inverter to convert a DC voltage to an AC voltage. Such devices are not believed to be commercially available at this time. When utilized in a device applying DC voltage, it is preferred to coat the phosphor particles with



coating can advantageously be used, such as a metal oxide selected from the group consisting of  $\text{SiO}_2$ ,  $\text{MgO}$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{ZnO}$ ,  $\text{SnO}_2$ ,  $\text{SnO}$ ,  $\text{ZrO}_2$ ,  $\text{B}_2\text{O}_5$ ,  $\text{B}_2\text{O}_3$ ,  $\text{Bi}_2\text{O}_3$ ,  $\text{TiO}_2$ ,  $\text{CuO}$ ,  $\text{Cu}_2\text{O}$ ,  $\text{In}_2\text{O}_3$  or  $\text{In}_x\text{Sn}_{1-x}\text{O}_2$  ( $(\text{In},\text{Sn})\text{O}_2$ ). Particularly preferred are  $\text{SiO}_2$  and  $\text{Al}_2\text{O}_3$  coatings. Semiconductive oxide coatings such as  $\text{SnO}_2$  or  $\text{In}_2\text{O}_3$  can be advantageous in some applications due to the ability of the coating to absorb secondary electrons that are emitted by the phosphor. Metal coatings, such as copper, can be useful for phosphor particles used in direct current electroluminescent applications, discussed hereinbelow. In addition, phosphate coatings, such as zirconium phosphate or aluminum phosphate, can also be advantageous for use in some applications.

Please replace the paragraph at page 85, starting at line 18, with the following:

Particularly preferred phosphors for use in electroluminescent display applications include the metal sulfides such as  $\text{ZnS}:\text{Cu}$ ,  $\text{BaS}:\text{Ce}$ ,  $\text{CaS}:\text{Ce}$ ,  $\text{SrS}:\text{RE}$  ( $\text{RE} = \text{rare earth}$ ), and  $\text{ZnS}:\text{Mn}$ . Further, mixed metal sulfides such as  $\text{Sr}_x\text{Ca}_y\text{Ba}_{1-x-y}\text{S}:\text{Ce}$  ( $(\text{Sr},\text{Ca},\text{Ba})\text{S}:\text{Ce}$ ) can be used. Further, the thiogallate phosphors according to the present invention can also have advantages for use in electroluminescent displays.

Please replace the paragraph at page 87, starting at line 19, with the following:

As discussed above, preferred electroluminescent sulfur-containing phosphors for use in electroluminescent lamps include  $\text{ZnS}:\text{Cu}$  for blue or blue-green and  $\text{ZnS}:\text{Mn}$ ,  $\text{Cu}$  for orange. Other materials that are desirable for EL lamp applications include  $\text{BaS}:\text{RE}$ ,  $\text{Cu}$  or  $\text{Mn}$ ,  $\text{CaS}:\text{RE}$  or  $\text{Mn}$ ,  $\text{SrS}:\text{RE}$  or  $\text{Mn}$ , and  $\text{Sr}_x\text{Ca}_y\text{Ba}_{1-x-y}\text{S}:\text{RE}$  ( $(\text{Sr},\text{Ca},\text{Ba})\text{S}:\text{RE}$  (where  $\text{RE}$  is a rare earth element) for other colors.  $\text{CaS}:\text{Ga}$  or  $\text{Cu}$  and  $\text{SrS}:\text{Ga}$  or  $\text{Cu}$  are also useful. The thiogallate phosphors of the present invention, such as  $\text{SrGa}_2\text{S}_4$  and  $\text{CaGa}_2\text{S}_4$ , can be particularly advantageous for use in electroluminescent lamps. As is discussed above, many of these phosphors cannot be produced using conventional techniques and therefore have not been utilized in EL lamp applications. When used in an EL lamp, these phosphors should be coated to prevent degradation of the phosphor due to hydrolysis or other adverse reactions. Preferably, such a coating has an average thickness of from about 2 to 50 nanometers.